Workshop A

Promises and Problems Associated with Agricultural Biotechnology

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Participants in Workshop A addressed the following questions: What are the greatest promises offered by biotechnology for improving production of more, higher quality foods in an environmentally friendly and sustainable fashion? What are the greatest hazards to the sustainability of agricultural food production imposed by biotechnology?

Approximately 12 to 15 people in each of five different breakout groups discussed the two questions. In the first of three successive sessions, the participants initially listed over fifty "promises" offered by biotechnology to agriculture and world food supplies and, likewise, over forty potential "problems" associated with the use of biotechnology in agriculture. In a second session they identified what they considered the promises and problems of greatest significance. In the final session, delegates worked together to assemble consensus statements and potential policy recommendations upon which they could agree. Assembled below are listings of the major promises and problems that were identified in Workshop A.

PROMISES OFFERED BY AGRICULTURAL BIOTECHNOLOGY

1. Enhanced quantity, quality, and end-use value of food, feed, and biomass products:

With few exceptions, Workshop participants agreed that biotechnology offers the promise of increased agricultural productivity throughout the world by speeding the development of crops that yield more, are more resistant to biotic and abiotic stresses, and are more economic and efficient to produce. The technology also allows the creation of healthier, more nutritious foods through manipulation of key metabolic pathways in plants and animals. Modification of

fruits, vegetables, and grains to ripen more uniformly, retain freshness and nutritional quality, and resist post harvest damage by insects and toxin-producing microbes were viewed as goals now within the reach of agricultural scientists using the tools of molecular biology and genetics.

Into this category of "promises" also falls the possibility for new, high-value plants and animals. Development of modified or alternative crops with specific traits and values now can be envisioned through the use of accelerated breeding techniques and genetic engineering of plants to possess new and unique characteristics. Economic production of biomass for the ever-growing world need for fuels and energy, and the creation of plants to supply specific, industrial raw products, are two goals that were viewed as closer than ever to reality due to the powerful tools of plant molecular biology.

Transgenic plants and animals are presently producing several high-value medicines in quantities unprecedented in the pharmaceutical industry. The production of specialty crops and animals was seen as one of the potential bright spots for enhancing income for farmers who position themselves to take advantage of the emerging opportunities offered by biotechnology.

2. Positive environmental impacts:

Changes in current agricultural production practices are possible through biotechnology. Development of plants genetically engineered to resist certain insects already has been widely adopted by the farming community and has resulted in significant decreases in the use of chemical insecticides in major crops such as cotton and corn. The use of herbicide-tolerant crops is allowing the adoption of conservation tillage practices at an accelerated pace while creating a favorable economic return on investment to farmers. It was pointed out that the types of herbicides for which herbicide-tolerant crops are being developed are generally those that can be used in lower quantities than earlier herbicides, have less persistence in soil, and do not create water quality concerns.

Additional promises are seen for the future in protecting and restoring the environment. Increased knowledge of plant and microbial metabolism and genomes was seen as leading to the production of plants and other organisms with enhanced ability for bioremediation of contaminated soils and water. The development of "green raw materials" for industry and for energy production can be accelerated through biotechnology. Enhanced carbon sequestration by genetically modified plants might play a role in minimizing the speed of global warming. Plants and animals that need fewer external inputs (especially those that are environmentally damaging) are likely to emerge from genetic engineering. Delegates agreed that world population would likely continue to increase over the next few decades. It was surmised that if new discoveries in biotechnology could lead to greater agricultural productivity per unit land area, there could be a concomitant decrease in utilization of certain natural resources

(e.g., water) and a decrease in pressure to farm marginal or environmentally sensitive lands throughout the world.

It was the consensus of the Workshop groups that biotechnology offers promise to improve the sustainability of agricultural production. However, it was emphasized that biotechnology alone was clearly not enough. Improvements through biotechnology must be coupled with excellent farm management practices including improvements in integrated pest management, cropping and soil conservation practices, and habitat preservation. These must be coupled with increased public awareness of the challenges associated with food production and environmental preservation.

3. Accelerated pace of scientific discovery:

Several comments were offered regarding the marked increase in the rate of scientific discovery as the result of new techniques associated with biotechnology. For example, the soon-to-be-completed dissection of the genomes of several plants, animals, and microbes and the ability to rapidly modify the genetic makeup of these organisms in precise ways was viewed as leading to an explosion in the knowledge and understanding of biological systems. This knowledge inevitably will fuel an increased pace of scientific discovery and an increased ability to manipulate organisms in ways that are beneficial to society. The ability of agriculture to supply the food needs of individuals worldwide in an efficient and environmentally sound fashion is likely to be greatly enhanced. Participants concluded that bringing this promise to fruition would require increased public and private funding to support the necessary research. Even more importantly, the group felt that it was essential that there be significant improvement in cooperation between governments, industries, and people worldwide in developing fair and equitable policies governing food production systems, market structures, and distribution channels.

POTENTIAL PROBLEMS POSED BY AGRICULTURAL BIOTECHNOLOGY

1. Environmental concerns:

Uncertainties in regard to potential environmental impacts of genetically modified plants and animals were a concern in all the Workshop groups. The consensus was that significantly more research was necessary to adequately assess the magnitude of perceived dangers and to discover means to prevent or deal with those dangers determined to be real. Immediate concerns included gene drift from transgenic to nontransgenic plants, the emergence of insects tolerant to insecticidal proteins contained within “insect-resistant” plants, the emergence of microbes tolerant to the “disease resistance” provided to plants and animals genetically engineered with single, disease resistance genes, and the potential collateral to non-target organisms caused by use of these new technologies (the prime example at the time of the meeting being concern that

corn pollen containing the Bt-toxin protein might harm monarch butterflies feeding on milkweed plants bordering corn fields). A concern also was raised that the need to "own" genes created through biotechnology was helping to fuel consolidation within the seed industry. Fears were expressed that fewer breeding programs and fewer commercially available varieties might lead to significant narrowing of the germplasm base for the major agronomic crops. It was posited that the resulting "mono-culture" might lead to rapid and catastrophic loss of worldwide production of one or more crops. More generally, there were mixed views as to whether biotechnology would help or hinder the goal of maintaining biodiversity on the planet.

2. Economic and legal issues:

Although effort was made not to tread too heavily into the questions being addressed by Workshop B participants, the members of the Workshop A discussion groups felt there were points that they should raise that fall into the economic, legal, and social arenas. In regard to legal matters, there were concerns that there might be reduction of free exchange of information in the academic world due to the rapidly increasing practice within universities of securing intellectual property rights for new discoveries and technologies. Likewise, there were strong opinions that ownership of new and highly valuable genes and germplasm controlled by private sector companies was likely to limit germplasm exchange and, thus, have a detrimental effect on the ability of public plant breeders in universities to maintain viable breeding programs. More importantly, economic considerations might limit the flow of new germplasm and genes to breeders and farmers in developing nations for use in endogenous crops.

With an eye to the future, questions were raised in regard to who will control the direction of agricultural research in years to come. With private industry now doing much of the cutting edge research in agriculture and controlling access to the marketplace through seeds, will it be possible for university researchers to embark on new projects with practical aims without first gaining agreement from a commercial organization to permit marketing of the research "product?"

It was noted that control of key genes or technologies by a fully integrated company (or a group of industrially coordinated companies) could lead to control of access to high-value crop varieties and control of production of these varieties. It was surmised that both of these situations could have strong negative implications for the farming community if companies are not willing to share equitably in the increased value of the crop.

3. Societal issues:

Concerns were voiced that the benefits of agricultural biotechnology may be available only to those who can afford it. If the profit motive is the prime

determinant in the implementation of biotechnology, then poor people in developed and developing countries may be denied access to the benefits of biotechnology. Participants suggested that mechanisms allowing reasonable returns on investment and, at the same time, fair and equitable access to genes and germplasm need to be developed on a global scale.

The control of specific, high-value crop varieties by one or a few companies was viewed by some as opening the way for a significant increase in contract farming. In the extreme, this situation could lead to tight controls of production practices by a company, as well as control of profit margins for the contract farmer. Pressures to produce on a larger, "more efficient" scale might lead to fewer farms and fewer farm families. This was seen as leading inevitably to farm communities that are economically (and socially) nonviable. In addition, there could be a loss of choice for farmers reflected in a growing dependency on specific new technologies — and, business-wise, a dependence on the source of those technologies.

Interestingly, at the time of NABC11, there was significant concern that the "fear" of genetically modified foods in Europe might slow or block the adoption of genetically engineered crops in the U.S. and around the world. However, in none of the Workshops was the "safety" of foods derived from biotechnology raised as a potential "problem." One cannot help but wonder if the same NABC11 had been held in Europe would the discussions and conclusions have been significantly different?